# THE DENTAL PRACTITIONER
## AND DENTAL RECORD

*Vol.* VI, *No.* 8 — *April*, 1956

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## EDITORIAL NOTICES

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References to dental literature should be recorded in the text, with the name of the author and the year of publication in parentheses. In the bibliography they should be arranged in alphabetical order in the following form, the abbreviations of periodicals being those adopted in the *World List of Scientific Periodicals* (1952), e.g.:—

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LEWIS, R. W. B. (1947), *The Jaws and Teeth*, 2nd ed., 471. London: Science Publishing Co.

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*Continued on page vi . . .*

# THE DENTAL PRACTITIONER
## AND DENTAL RECORD

Vol. VI, No. 8 April, 1956

EDITORIAL

## TIME FOR THOUGHT

ONE of the oldest jokes published in *Punch* is the story of the country yokel sitting outside the village inn, who, when asked what he did in life, replied: "Sometimes I sits and think, but most times I just sits." With the pace of modern life there is little time to sit, never mind to sit and think out our problems. The village character with his own particular philosophy lives a life of ease and quietude compared to the busy practitioner who rarely has a minute in his day to stop and pause for thought. However, if the practitioner suddenly found himself with nothing to do except to sit and think he would not find life so idyllic or so sweet as the village yokel obviously did. Nor so profitable. It is always a strange thing in life that we grumble when we are overworked and grumble again when we have too little work. There is a happy medium between these two extremes if only we could find it, but then again we make ourselves believe we have no time to sit and think to discover where the demarcation line lies. The man who works solidly from morning until nightfall is just storing up troubles for the future and will regret it too late. There should always be a part of the day set aside for sitting and thinking, even if it is only for half an hour at lunch time. Relax in a large chair and put the feet up on the mantel-piece, and, if no thoughts come, then just sit. The practitioner and his patients will benefit from a practice organized and run in such a fashion that there is always time to sit and think. Easter and Whitsun are traditional times for conferences in many professions and trade unions. A conference usually means some hard sitting and hard thinking performed in the hope that the results will be worth while, which in general they usually are. Conferences must be arranged long beforehand and require a carefully scrutinized agenda to keep within the time limit, so that much of the work of a conference is never seen. These unseen preconferences are all important and their example may be taken to heart by all of us. There should always be time for thought and private conference, not only in the practice but in the home, provided of course that we can find the time.

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### DENTAL BOARD OF THE UNITED KINGDOM

The Board will meet in public session for general business at 12.0 noon on Wednesday, May 9, 1956.

# SOME DISORDERS INVOLVING TOOTH AND BONE*

By **MARTIN A. RUSHTON**, M.D., F.D.S.

THERE are so many similarities between bone on the one hand, and dentine and cementum on the other, that one would expect the tooth to be frequently involved in disorders involving bone: and so it is. But as there are many differences also between bone and dentine and cementum, so we also find that these dental tissues are often either spared or affected in a manner different from that in which bone is affected.

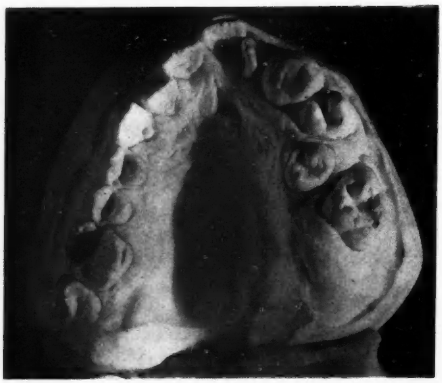

*Fig.* 1.—Congenital hemifacial hyperplasia. Enlarged teeth in the left maxilla.

Let us first examine some cases where the teeth and bone appear to be affected in a similar manner. This is well seen in some regional growth disorders of very early onset, such as congenital unilateral hyperplasia of the face. Here the enlargement affects both hard and soft tissues, and in a certain proportion of cases the teeth also. The teeth in fact show growth disorders of two sorts: some of them form organs of a larger size than on the normal opposite side (*Fig.* 1), especially in the case of the deciduous second molar, the permanent canine, first molar, and first premolar; and their growth and development are also accelerated whether they are enlarged or not. Thus, in examples seen at 5 or 6 years of age, all the deciduous teeth may be in position on the normal side and most of the permanent ones erupted on the enlarged side.

*Fig.* 2.—Congenital hemifacial hyperplasia. Skull at 7 years. (Barwell's case.)

It seems likely that the bone is affected in this double manner also, and that there is some tendency for the bony asymmetry to be less in the adult than in the child (*Fig.* 2) because the normal side has ultimately caught up to some extent.

In congenital hypoplasia of one side of the body, including the face, I am able to show you an opposite effect, teeth being smaller on that side though not retarded (*Fig.* 3). When a growth disorder is of later onset, it is obvious that the size of teeth is not likely to be affected, with the possible exception of the third molars. In a case of progressive facial hemiatrophy first noticed at 4 years (*Fig.* 4), there has been retardation of development and eruption of the teeth on the affected side, as well as

* A paper given to the Odonto-Chirurgical Society of Scotland on Thursday, December 8, 1955.

defective development of the bone, so that the first lower molar is still incompletely erupted at 10 years and the second molar looks as if it will be impacted (*Fig.* 5).

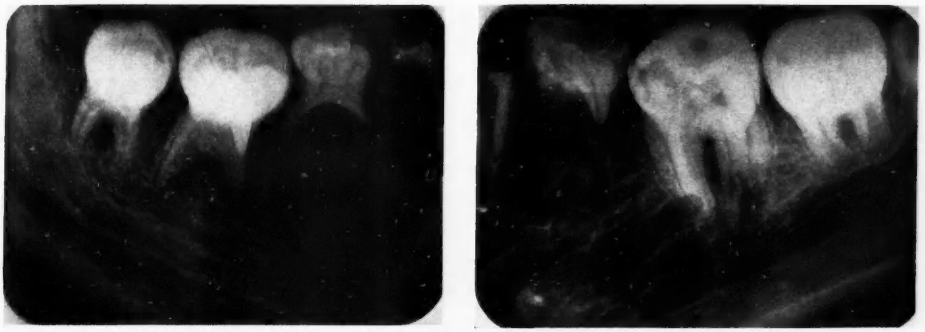

*Fig.* 3.—Congenital hypoplasia of right side of the whole body. Smaller deciduous and permanent teeth on the right side.

*Fig.* 4.—Progressive facial hemiatrophy at 10 years.

In the next group let us consider some cases in which the cause of some general or regional disturbance of bone does not affect the teeth or does so in a modified manner owing to the anatomical peculiarities of the dental tissues. For example, in hyperparathyroidism, while the bone around the teeth is notoriously often resorbed (*Fig.* 6) and is replaced by bone of a different pattern or by a characteristic fibrous tissue, the roots of the teeth are almost never resorbed and the dentine also is not removed by any process arising in the adjacent tooth pulp. We can see an anatomical reason for this, for the surface of the root, in a young person at least, is protected from resorption by its continuous surface layer of uncalcified

*Fig.* 5.—Progressive facial hemiatrophy. Radiographs of jaws at 10 years. Retarded dentition and defective bone development on the left side.

cementum (*Fig.* 7), and the dentine on the pulp side by an equally continuous layer of predentine. There is every indication that

*Fig.* 6.—Hyperparathyroidism. (*Radiographs by courtesy of Dr. F. L. Ingram.*)

*Fig.* 8.—Part of mandible of dog with hyperparathyroidism following renal disease, showing great loss of bone, especially around the teeth.

these incompletely calcified and recently formed collagenous substances are only resorbed with difficulty and usually only some time after the surface layers of cementoblasts or odontoblasts have been damaged.

In the quite exceptional cases of hyperparathyroidism where the roots of the teeth are resorbed, it must be supposed that this additional damage to cementoblasts or odontoblasts has occurred either from periodontal disease or mechanical injury.

Similar events are seen in secondary hyperparathyroidism following renal disease and, most strikingly, in the so-called "rubber-jaw"

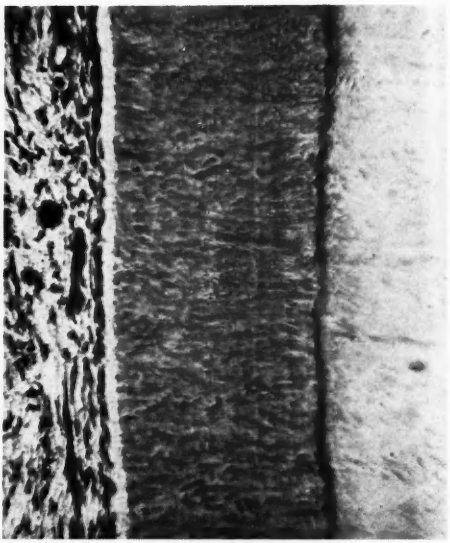

*Fig.* 7.—Tissues from right to left are dentine, cementum, a layer of uncalcified cementum, and periodontal membrane. Hæmatoxylin and eosin. (× 120.)

condition in dogs where the teeth are preserved intact in an area almost completely deprived of bone (*Fig.* 8). It is interesting also to observe in these cases that although the alveolar bone has been lost, this does not entail the formation of periodontal pockets or permit the downgrowth of the epithelial attachment, for the periodontal fibres remain intact and cementum formation is active (*Fig.* 9). It is evident that loss of bone is not in itself a very strong predisposing factor to the onset of periodontal disease and that periodontal fibres can persist strongly attached to the tooth on the one hand and to fibrous tissue masses on the other, even when no bony attachment remains.

Similar considerations apply in Paget's disease of bone (*Fig.* 10). In the bone there is an early phase which is principally osteolytic (*Fig.* 11), followed next by a phase in which excessive bone resorption is accompanied

by excessive bone apposition and by other events which need not be described now. In the teeth there is usually no reaction at all

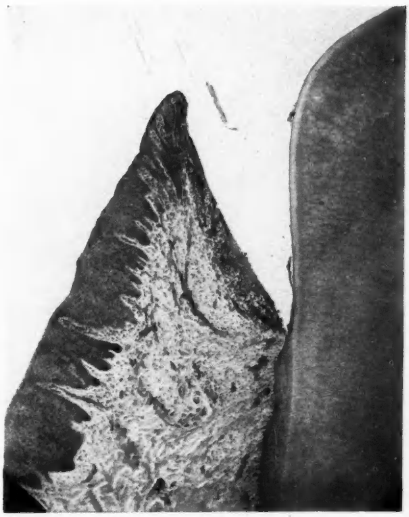

*Fig.* 9.—Section through tooth and gum of same dog, showing absence of pocket formation. Hæmatoxylin and eosin. (× 30.)

in the early years of the disease, even though the bone around them may show marked osteoporosis. In later years, however, as is well known, the teeth often show a characteristic and extreme hyperplasia of the cementum (*Figs.* 12–14).

Thus, just as in hyperparathyroidism, the teeth show a marked resistance to the resorptive process which is so active in the surrounding bone; but in Paget's disease the hypercementosis shows that they share the tendency which the bone has to produce very large deposits of collagenous material. Just as there are rare cases of hyperparathyroidism where root resorption does occur, so there are occasional cases of Paget's disease where it can be recognized that resorption has preceded cementosis and even accompanied it to some degree (*Figs.* 15, 16). One would suppose that in such cases there are additional factors, mechanical or toxic, which have damaged the surface of the root. It is not easy to say what pulp changes are characteristic of Paget's disease, since the teeth involved show changes which could also be ascribed to age and other factors, but it looks as if there is some tendency

*Fig.* 10.—Paget's disease affecting the maxillæ, especially on the left, as well as skull and pelvis.

*Fig.* 11.—At the margin of the area more characteristically affected, the bone shows osteoporosis with prominence of the trabeculæ which are of most structural importance. Right upper premolar region of same patient shown in *Fig.* 10.

to obliteration of the pulp cavity with calcified collagenous material in those teeth which show great proliferation of cementum. While the relative immunity of the teeth from resorption is comprehensible on the lines mentioned in connexion with hyperparathyroidism, the great degree of cementosis requires further consideration. It appears possible that it may be in part a compensatory phenomenon related to the alteration in structure and quantity and probably loss of mechanical properties of the bone to which the tooth was attached. The effect is certainly to produce a tooth which, while lodged in soft

bone, is nevertheless strongly, though flexibly, attached and often difficult to remove. This explanation would be in line with the view of

*Fig.* 12.—Lower incisor region showing osteoporosis of Paget's disease with early hyperplasia of cementum.

*Fig.* 14.—Advanced cemental hyperplasia on first lower molar of a man with Paget's disease affecting mandible and skull.

those who hold that much of the hyperostosis in Paget's disease is a compensatory effect consequent upon the weakening of the bone structure by resorption.

There is another consideration also which may be illustrated by what happens commonly in the upper jaw. Here the bone is enlarged, often very greatly, by apposition of bone on its surfaces, including the alveolar process.

*Fig.* 13.—Maxilla of same patient as *Fig.* 12, showing advanced bone changes and advanced hyperplasia of cementum.

If the teeth remained inactive they would become progressively submerged in the bony mass, just as, for example, the crowns of teeth become submerged in general hyperplasia of the gums. But this does not happen and the teeth generally erupt *pari passu* with the enlargement of the bone. Now we know that part of the normal mechanism of continued eruption of teeth in adult life is the progressive apposition of cementum around the apices and elsewhere, and it may be that the great cementosis in Paget's disease is in this respect also to be considered a compensatory feature, either the cause or the result of the enormously accelerated vertical movement of the teeth.

Again, in spite of the disorganization of the alveolar bone and the advanced age of many patients, deep periodontal pockets are not a characteristic feature. I think this must be attributed to the great activity of cementum formation (which may sometimes be such as to form an abrupt shelf or buttress just beneath the gum), for it is incompatible with this activity that the epithelial attachment should grow down the root.

So far then, we have in hyperparathyroidism a condition where the teeth are apparently protected from changes similar to the bone changes by an anatomical feature; in Paget's disease a condition where it is probable that the teeth are generally protected against resorption in the same way, but in which as regards excessive apposition of new matrix, they show similar changes to the bone in the same area and in succession to these. We do not find cases of Paget's disease in which teeth show the characteristic changes independent of local bone changes.

*Fig.* 15.—Radiographs of lower teeth of patient from whom the tooth shown in *Fig.* 14 had just been removed. It is clear that resorption of tooth substance had preceded cementosis in many teeth.

This is quite different from what we find in the case of osteogenesis imperfecta and opalescent dentine. It may well be that in osteogenesis imperfecta the teeth and bone, when both are affected, show changes which are in principle the same. But the changes in the two tissues are not interdependent. Not only do we find cases of osteogenesis imperfecta in which the teeth of one dentition at least are normal—the second quite commonly and the first sometimes—but relatives without bone fragility may apparently have the abnormal teeth in normal bone. Further, we know that families with precisely similar abnormal teeth, but without any bone fragility and with normal jaws, are not uncommon, the condition being then known as hereditary opalescent dentine or by other names. In these conditions the effects cannot depend in essence either upon a general systemic cause or even a regional effect embracing the jaws, but must be conditioned by an extremely local abnormality which can reside in the formative tissues of either the bone, the teeth (and not necessarily all of them or even the whole of them), or certain fibrous structures, separately, or in several of these together.

*Fig.* 16.—Cemental hyperplasia in Paget's disease. A mosaic pattern analogous to that found in bone may be observed. Picrothionin. (×40.)

At least, however, in osteogenesis imperfecta when both teeth and bone are affected they are deranged in a comparable manner. In other disorders, such as cleidocranial dysostosis, it has so far defied the wit of man to

correlate the odd assortment of defects which may be found in bone and teeth. On the one hand, we have the defects of skull and clavicles and often other bones, chiefly characterized by growth deficiencies: on the other, we have the specific dental abnormality of failure of eruption of permanent teeth, equally common in the mandible which grows normally and in the maxilla which does not, together with a superabundant formation of teeth. To add to the complexity of a puzzle in which none of the pieces fit together, I have recently discovered that most of the teeth in this condition which I have examined are almost devoid of cellular cementum, a thing which so far as I know does not occur in the adult tooth in any other condition. It would be nice to correlate this with the failure of eruption in some way but I am unable to do this, for teeth in other conditions which fail to erupt usually have abundant cellular cementum and some teeth in the dysostosis which do erupt show the same lack of cellular cementum as those which do not. The cemental defect is thus neither the cause nor result of failure eruption.

It has only been possible to indicate some similarities and differences in the behaviour of bone and dental hard tissues in relation to local and general disturbances, but it is hoped that it may be enough to create interest in a subject which deserves much fuller exploration than it has yet received.

# SOME OBSERVATIONS ON THE EFFECT OF COMPRESSION ON IMPRESSION MATERIALS WHICH ARE MADE FROM REVERSIBLE AND IRREVERSIBLE HYDROCOLLOIDS AND RUBBER-BASE MATERIALS

By **E. L. HAMPSON**, M.D.S. (L'pool), H.D.D. (Edin.), F.D.S. (Eng.)

WHEN hydrocolloids were first used in dentistry it was realized that compressive strength and resistance to deformation were reliable tests of their value, as materials for taking impressions. In 1940 Paffenberger published a report on the physical properties of the reversible hydrocolloids and suggested a specification which became the "American Dental Association's Specification No. 11 for Hydrocolloidal Impression Materials". A satisfactory elastic impression material was expected to be sufficiently rigid to resist excessive deformation when plaster-of-Paris was poured into the mould, to be able to pass over undercuts without breaking, and to return to its original shape after it had been deformed. These characteristics expressed in laboratory terms are the compressive strength of the material, its set or the permanent deformation resulting from strain, and its strain or the deformation produced by a given load.

Some months ago a rubber-base elastic impression material was introduced to the dental profession. One specimen had a composition of: (1) Salicylaldehyde and hydroxybenzaldehyde; (2) Rubber solution and paraffin oil; (3) Powdered latex; (4) Zinc oxide; (5) Iodine in combination with an alginate. Because these materials resemble the hydrocolloids in some of their methods of manipulation and in their composition it was thought that if they were put to the same tests as those which are specified for the hydrocolloids a fair comparison could be made between the three kinds of elastic impression materials which are available for taking impressions of inlay and bridge cavities.

Hence in the present investigation the compressive strengths, strain, and permanent set were determined for the reversible and irreversible hydrocolloids and the rubber-base compounds, and in most of the experiments the methods recommended in the Specification were followed. James Cresson (1949) had, however, expressed the opinion that the tests suggested by the American Dental Association "serve as a fairly good guide in the evaluation of an impression material but do not, in every case, yield results which are comparable". Cresson's observations were confirmed in this research and whenever the specification was found to be deficient additional tests were carried out.

Since the purpose of the work was to determine the effect of certain variables on the accuracy of the elastic impression materials in general, and not to indicate advantages of any particular product, they will be referred to by a code letter and not by name. The materials were Dentocoll, Deelastic, D.P. Compound, a mixture suggested by Thomson (1951), Zelex, Omix, Tissutex, Coeloid J, Getz K, Permaflex, Scania, Static, Permlastic, and the code letters were A, B, E, F, G, H, I, J, K, L, M, N, O.

The recommendations of the American Dental Association for hydrocolloid impression materials are as follows:—

**Strain in Compression.**—

*a*. The strain shall not be less than 4·0 nor more than 20·0 per cent between a stress of 100 g./cm.$^2$ (1·42 lb./in.$^2$) and a stress of 1000 g./cm.$^2$ (14·2 lb./in.$^2$).

*b*. The set shall not exceed 3·0 per cent when stresses of 100, 1000, 0, and 100 g./cm.$^2$ are applied for one-minute intervals in the foregoing sequence.

**Compressive Strength.**—The compressive strength shall not be less than 2000 g./cm.$^2$ (28·45 lb./in.$^2$).

**Methods of Inspection and Test.**—

1. *Preparation of Test Specimens.*—The specimens shall be prepared in accordance with the mixing directions which accompany the package.

2. *Strain in Compression.*—So as to prepare the specimen for the test a ring shall be placed on a flat glass plate and shall be slightly more than one-half filled with the heated plastic material. A mould shall immediately be placed inside the ring and shall be forced into the material until the mould comes into contact with the glass plate and the material has exuded on top of the mould. A flat metal plate shall be pressed on top of the mould to remove excess material. One-half hour later the ends of the specimen shall be made flat and parallel, if necessary, by drawing the mould containing the specimen across No. 00 abrasive paper. The specimen shall then be removed from the mould and placed in an atmosphere of 100 per cent relative humidity at 20–25° C. (68–77° F.) for approximately one-half hour.

The specimen shall then be transferred to an appropriate instrument and shall be subjected to a load calculated to produce a stress of 100 g./cm.$^2$ (1·42 lb./in.$^2$). Thirty seconds later the dial indicator shall be read. This value shall be designated as reading A. Sixty seconds after applying a stress of 100 g./cm.$^2$ (1·42 lb./in.$^2$) an additional load calculated to produce a total stress on the specimen of 1000 g./cm.$^2$ (14·2 lb./in.$^2$) shall be gradually applied during an interval of ten seconds. Thirty seconds after beginning the application of the stress of 1000 g./cm.$^2$ a reading of the dial indicator shall be taken. This reading shall be designated as reading B. The difference between readings A and B divided by the original length of the specimen (the original length of the specimen shall be considered as the height of the mould used in forming it), times 100, shall be considered as the percentage of strain between the stresses of 100 and 1000 g./cm.$^2$

Sixty seconds after beginning the application of the stress of 1000 g./cm.$^2$, the specimen shall be released of all stress for a period of sixty seconds. Then a load calculated to produce a stress of 100 g./cm.$^2$ shall be applied on the specimen for thirty seconds, when a reading of the dial indicator shall be taken. This reading shall be designated as reading C. The difference between readings A and C divided by the original length of the specimen, times 100, shall be considered as the set in per cent.

The specimen shall be tested at 20–25° C. During the test the specimen shall be protected by moistened cloth gauze to prevent excessive moisture losses. The gauze shall be wrapped loosely about the specimen so as not to support it. After the test the specimen shall be returned to an atmosphere of 100 per cent relative humidity and stored there until the test on compressive strength is started. The value for strain and for set shall be reported as the average of tests on three specimens and shall be recorded to the nearest 0·1 per cent.

3. *Compressive Strength.*—When the specimens which were used in the tests for strain and set are two hours old they shall be subjected to the test for compressive strength. Successive loads calculated to produce a stress of 400 g./cm.$^2$ (5·68 lb./in.$^2$) shall be applied at sixty-second intervals until rupture occurs. Each stress increment shall be gradually applied during a ten-second interval.

The environment of the specimen during the test shall be the same as that specified.

At least two of the three specimens shall support a stress of 2000 g./cm.$^2$ (28·4 lb./in.$^2$) without rupturing.

As explained earlier, the amounts of strain, set, and compressive strength of the materials were measured in this investigation according to the method prescribed in the American Dental Association's specification. *Fig.* 1 illustrates the ring and mould which were used in the experiments. The ring had an inside diameter of $\frac{61}{64}$in. and a height of $\frac{5}{8}$ in. and the mould an outside diameter of $\frac{15}{16}$ in., an inside diameter of $\frac{1}{2}$ in. and a height of $\frac{3}{4}$ in. The appropriate instrument for testing

the specimen was a solid metal stand which held a movable upright rod supporting at its upper end a platform on which weights were placed and with its lower end passing into the dial gauge (*Fig.* 1). The dial gauge was

*Fig.* 1.—Apparatus which was used to determine the strain and set of the materials which were tested.

accurate to a 1/1000 in. and had its pointer resting on a small metal plate which was placed on the top of the cylindrical specimen. The total weight applied included that of the rod and platform and the specimen was surrounded by a piece of moistened gauze so that it might not lose moisture.

The specification recommends that, before the specimen is tested, it should be "aged" for half an hour in air of a relative humidity of 100 per cent.

This recommendation was followed for the reversible hydrocolloids and for the rubber-base compounds, but not for the irreversible ones because the physical properties of the latter depend on the formation of an insoluble gel by a chemical reaction which continues for a considerable time after gelation has occurred. It was, therefore, thought that if alginates were tested only a few minutes after they had been removed from the mould a more accurate measure would be obtained of their ability to pass over undercuts and to regain their original shape.

## RESULTS

Values for strain and set were obtained between stresses of 100 g./cm.$^2$ and 1000 g./cm.$^2$ The value for strain would appear to be a sound measure of the rigidity of the materials and, since the amount of strain for a given load can be measured for all the materials, it serves as a means of comparing the samples tested. The data for set can also be compared, and the conclusions drawn from the comparisons are valuable. The material with the lowest value for set should obviously be the most suitable for taking impressions, because the lower the value the smaller is the amount of permanent deformation which takes place when the material is drawn over undercuts. Skinner and Pomes (1947) drew attention to this after conducting experiments in which they applied stresses of 27·6, 400, 0, and 27·6 g./cm.$^2$ at intervals of $\frac{1}{2}$, 1, 2, and $2\frac{1}{2}$ min. respectively. Discussing their results they stated that "not only must the impression be strong enough not to fracture on withdrawal, but also it must be sufficiently rigid and possess the proper elasticity to return closely to its original shape after it has been withdrawn over undercuts. Consequently, the lower the amount of permanent set values shown . . . the more satisfactory is the material". A study of the graphs made during this investigation will make it clear that values for set vary with different amounts of strain, and that to obtain a true picture of the behaviour of the materials it is essential to estimate the set over a wide range of stresses. Therefore, it was not considered sufficient to obtain values for set at stresses of 100 g./cm.$^2$ and 1000 g./cm.$^2$, and in this investigation loads increasing by 125 g./cm.$^2$ were applied so that set/strain curves could be plotted between 100 g./cm.$^2$ and 1000 g./cm.$^2$ From a study of the curves and tables (*Figs.* 2–4) the relative amounts of set at a particular strain could be obtained, and were an indication of the behaviour of the materials when drawn over undercuts. The results proved that most of the materials gave strain and set values

within the limit set by the American Dental Association, and an examination of the graphs (*Figs.* 2–4) should assist in evaluating the relative merits of the different materials.

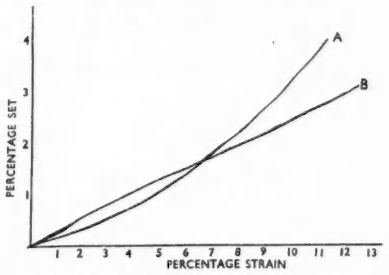


*Fig.* 2.—Graph which shows the relation between set and strain of alginates I and B. Key to diagram: A, material I, and B, material B.

The values for strain and set between 100 g./cm.$^2$ and 1000 g./cm.$^2$ are given in the following table:—

| *Material* | *Strain* per cent | *Set* per cent |
|---|---|---|
| Reversible hydrocolloid F | 12·4 | 1·3 |
| ,, ,, A | 14·0 | 2·0 |
| ,, ,, G | 9·7 | 1·9 |
| ,, ,, H | 12·5 | 3·5 |
| Irreversible hydrocolloid I | 11·5 | 2·9 |
| ,, ,, E | 11·5 | 3·0 |
| ,, ,, B | 12·0 | 3·0 |
| Rubber-base material M | 4·0 | 0·93 |
| ,, ,, L | 5·6 | 0·9 |
| ,, ,, N | 6·4 | 1·2 |
| ,, ,, O | 5·3 | 0·8 |

Another property which a good elastic impression material should possess is stiffness. To estimate this property the amount of strain developed by gradually increased loads was measured up to the point immediately preceding the point at which the specimen was ruptured for the reversible hydrocolloids. As in the other experiment, increments were in amounts of 125 g./cm.$^2$ and the reading of the dial gauge was taken just before the specimen ruptured. The strain in cm./cm. was plotted against the stress in g./cm.$^2$, and from this graph (*Figs.* 5, 6) the strain which would be expected from a given load could quickly be estimated and the relation between stress and strain easily studied. The slope of the graph (*Fig.* 5) indicates the relative stiffness of the specimens which were tested. Those which produced the steeper curves were the stiffer materials, and numerical values for stiffness were determined by dividing the stress by the strain. The following table represents the

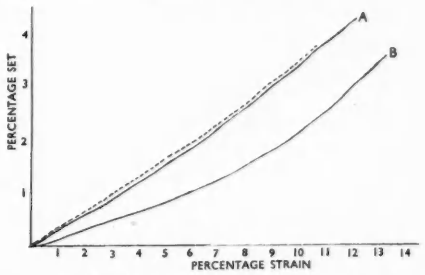


*Fig.* 3.—Graph which shows the relation between set and strain of alginates K, E, and J. Key to diagram: – – – – – – material K; A, material E; B material J.

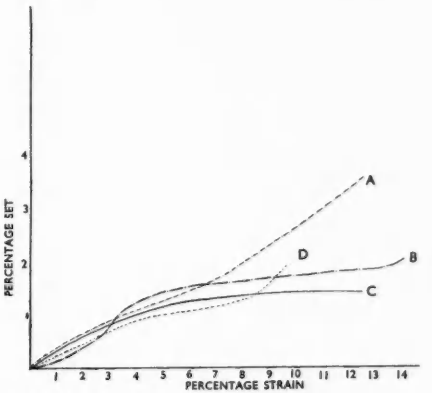


*Fig.* 4.—Graph which shows the relation between set and strain of reversible hydrocolloids H, A, F, and G. Key to diagram: –·–·–· material H; —·—·— material A; ——— material F; – – – – – – material G.

stress/strain ratio at the greatest increment prior to rupture and the higher the figure the stiffer was the material:—

| | |
|---|---|
| Reversible hydrocolloid F | 18,000 |
| ,, ,, G | 11,000 |
| ,, ,, H | 7500 |
| ,, ,, A | 11,666 |

Comparable information was not obtained for the alginates nor the rubber-base materials because the apparatus (*Fig.* 1) was found to be unsuitable for estimating the compressive strengths of these materials. Because the

compressive strengths of the alginates and rubber-base materials far exceed those of the agar-agar hydrocolloids a much more robust instrument, the Denison compression testing

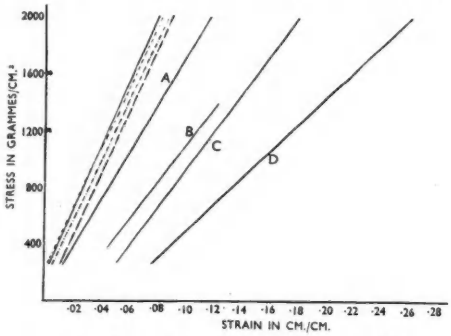


*Fig.* 5.—Graph to illustrate the degree of stiffness of rubber-base compounds and reversible hydrocolloids. Key to diagram: ——— material L; – – – – – – material M; –·–·–·–·– material O, — — — — material N. A, material F; B, material A; C, material G; and D, material H.

machine, had to be used, and on this machine only the load applied and the point of crushing are recorded.

The compressive strengths of the materials tested were:—

| | | | |
|---|---|---|---|
| Reversible hydrocolloid | F | 2200 g./cm.² | |
| ,, | ,, A | 1400 | ,, |
| ,, | ,, G | 2240 | ,, |
| ,, | ,, H | 2480 | ,, |

The compressive strengths of the alginates and rubber-base compounds were all greater than 3000 g./cm.²

The amount of strain developed just before the materials ruptured was also recorded and a comparison between this figure and the values for compressive strength is of interest because it shows that the amount of deformation the materials can withstand is not dependent on high compressive strength.

| | | *Compressive strength* | *Strain at point of rupture* |
|---|---|---|---|
| Reversible hydrocolloid | F | 2200 g./cm.² | 12·5 per cent |
| ,, | ,, A | 1400 ,, | 12·1 ,, |
| ,, | ,, G | 2240 ,, | 20 ,, |
| ,, | ,, H | 2480 ,, | 32 ,, |

From this table it will be seen that the specimen made from material A is weaker than any of the others and it might, therefore, be considered inferior to them because it might tear more readily. The figures quoted, however, show that this material can be deformed by 12·1 per cent of its length before it ruptures,

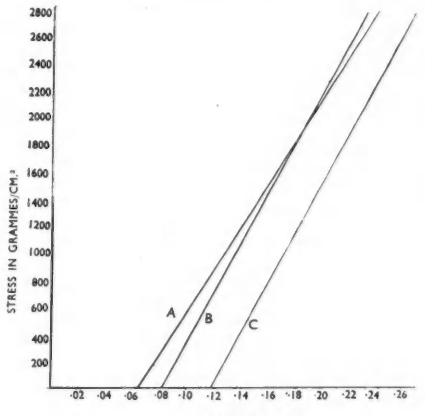


*Fig.* 6.—Graph to show degree of stiffness of alginates I, E, and B. Key to diagram: A, material I; B, material E; and C, material B.

a figure very near to that for material F which has a much higher compressive strength. Again, the strain developed by elastic compound H was considerably greater than that developed by material G, although their compressive strengths were much the same. These examples clearly show that the amount of deformation these materials can stand does not depend on high compressive strength.

## DISCUSSION

In this investigation most of the samples tested satisfied the requirements of the American Dental Association's Specification except reversible hydrocolloid H, which had a set slightly higher than the maximum allowed. This specification, however, applies more to the use of the materials in prosthetic dentistry where large surfaces and marked undercuts have to be recorded. It, therefore, follows that, if the specification requirements for set, strain, and compression are fulfilled, the material is satisfactory in these respects for use in conservative dentistry. In this field a much smaller area with less undercut has to be

recorded so that the force needed to remove the impression from the mouth is much less than that needed to remove an impression for a full or partial denture. By applying weights to a small box suspended from a crown tray while a Zelex impression was being taken the force needed to dislodge the impression was estimated. The average stress for three impressions was 31·8 g./cm.$^2$, which was well below the lowest stress specified by the American Dental Association. Hence it is reasonable to assume that in conservative dentistry if greater care is taken and the impression is withdrawn cleanly, the permanent dimensional changes caused by compression should be so small as to be almost negligible in the practical effect.

The results which were obtained from the experiments show that the rubber-base impression materials are stiffer than either the reversible or irreversible hydrocolloids. It is therefore likely that the more recently introduced materials will be less likely to distort when artificial stone is poured into the impression. For the rubber-base compounds the values for strain and set at stresses between 100 g. per sq. cm. and 1000 g. per sq. cm. were well within the limits of the American specification for hydrocolloids and were indeed small compared with the other elastic materials. This suggests that less temporary and permanent distortion would occur when stresses are applied to them.

Although the behaviour of the rubber-base impression materials under compression seems to be better than that of the hydrocolloids, the writer has not found that the rubber-base compounds give consistently good results in clinical practice. There must therefore be other possible sources of error which should be investigated so that a better method of manipulating the materials can be devised.

## SUMMARY

The American Dental Association Specification No. 11 for Hydrocolloidal Impression Materials has been quoted and an investigation of the compressive strengths, strain, and permanent set of both reversible and irreversible hydrocolloids and the rubber-base compounds were determined according to their recommendations. The information obtained indicated the way in which the hydrocolloids should be manipulated so that the best results can be obtained from their use in dental surgery.

The author wishes to thank Mr. A. B. Kesteven for his help in making the apparatus and the Photographic Department of the United Sheffield Hospitals who prepared the illustrations.

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### A Study of the Nerve-supply of the Upper Anterior Teeth

In a careful and well-illustrated paper, the authors have shown that: (1) The anterior superior alveolar nerve arises from the lateral or inferolateral aspect of the infra-orbital nerve. (2) The point of origin of the anterior superior alveolar nerve in the infra-orbital canal varies, being dependent on the number of branches involved in its formation. This may vary from one to three in number. (3) The filaments arising from the anterior superior alveolar nerves on the anterior aspect of the maxilla vary greatly in number from sparseness to a dense configuration. (4) There is a close proximity of the nasopalatine nerves to the apices of the upper central incisor teeth, although there is no evidence of any innervation of the pulps by these nerves. (5) In 53 per cent of the specimens examined there was no middle superior alveolar nerve.—OLSEN, NORMAN H., TEUSCHER, GEORGE W., and VEHER, KARL L. (1955), *J. dent. Res.*, **34**, 413.

# PARTIAL DISLOCATION OF TEETH

## A METHOD OF FIXATION WITH RESULTS OF TREATMENT AFTER 2½ YEARS

By CHARLES McKAY, M.D.S., L.D.S.

### CASE REPORT

A schoolgirl, aged 17 years, was seen on Feb.18, 1953, half an hour after being struck on the mouth by a hockey ball. The upper and lower lips were lacerated and $\underline{|12}$ had been displaced lingually by about 30° so that the opposing lower incisors came in contact with their labial surfaces when normal closure was attempted. There was some hæmorrhage from the gingival tissues, with loss of the epithelial attachment, but the teeth were not freely movable.

A radiograph (*Fig.* 1) showed the roots of the teeth to be intact. The periodontal membrane space appeared wide and because of the displacement $\underline{|12}$ appeared shorter than the adjacent teeth.

Under local anæsthesia the dislocation of the teeth was reduced and the alveolus remoulded. Using a crown tray, an impression was then taken in composition, and adapted as a special tray by enlarging the impression of the teeth with a filling instrument while still soft. Excess composition was removed so that the material was just clear of the gingival margin. This improvised special tray was then filled with self-curing acrylic resin and replaced in the mouth, where it was held firmly until the acrylic material had set, after which the tray was removed carefully. The acrylic resin remained firmly in situ as it had flowed between and around the teeth, and was of sufficient bulk to act as a splint, holding the injured incisors securely in their normal position. It had absorbed some stain from the composition, having a slightly brownish tinge, but was otherwise satisfactory. It was trimmed and smoothed around the gingival margin.

The patient was given antibiotic cover and the soft-tissue injuries healed normally. She was seen at frequent intervals, but there was no discomfort after the first two days. The splint was removed four weeks later. The clinical findings were then as follows: There was no response of $\underline{|12}$ to thermal change, *but no loss of translucency*. Re-attachment of the soft tissues was excellent, and the teeth were firm. There was no tenderness on percussion.

A radiograph taken after one month showed some resorption of the root apices. This was more marked after four months and one year (*Fig.* 2), but there was little further change eighteen months later. Two and a half years after the injury a radiograph (*Fig.* 3) showed lamina dura formation around the root apices. The periodontal membrane space was of a normal thickness. The pulp canals were almost completely obliterated by radiopaque material.

### DISCUSSION

The point of impact of the hockey ball appears to have been near the cervical margin of $\underline{|12}$. The teeth did not fracture but were apparently rotated in their long axes approximately about the apices, carrying the alveolus with them. It is known that teeth in young subjects, i.e., up to about 15 years of age, may be rotated surgically for orthodontic purposes without causing irreparable damage to their blood-supply owing to the vascular remains of the dental papilla around their apices, which adhere to the tooth when the latter is moved (Holland, 1955).

The fact that calcification of pulp has taken place during the last year shows either that the blood-supply remained intact or that it regenerated. Nerve tissue, on the other hand, is more friable, and in this case was probably torn by the sudden, though slight, movement at the apices. Fish (1948) discusses the pathology of such conditions, but does not mention possible damage to the nerve-supply.

*Fig.* 1.—Radiograph of $\underline{|12}$ showing the condition of the teeth before splinting.

*Fig.* 2.—Radiograph taken one year after injury showing resorption of root apices of $\underline{|12}$.

*Fig.* 3.—Radiograph taken 2½ years after injury. The pulp canals of $\underline{|12}$ are almost obliterated.

## SUMMARY

A method of fixation of teeth following injury is shown, with a description of the clinical and radiological findings over a period of two and a half years. The indications are that the blood-supply, unlike the nerve-supply, remained intact or regenerated following the injury.



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# A CASE OF ADAMANTINOMA OF THE MANDIBLE


By **E. S. BROADWAY**, B.D.S., F.D.S., D.Orth. R.C.S.

*Senior Registrar, St. Thomas's Hospital*


## CASE REPORT

A FEMALE patient, aged 30 years, was referred to the outpatient department complaining of a lump behind the last molar tooth. Intra-oral examination showed a small red tumour distal to the lower right third molar tooth. The tumour was sessile, and was not attached to the tooth. The second and third molars were found to be loose. The teeth were not carious and the parodontal condition was good.

Radiographs of the right mandible showed a large cystic cavity with partial amputation of the roots of the second and third molar teeth. (*Fig.* 1.)

*Fig.* 1.—Shows the pre-operative radiographic condition.

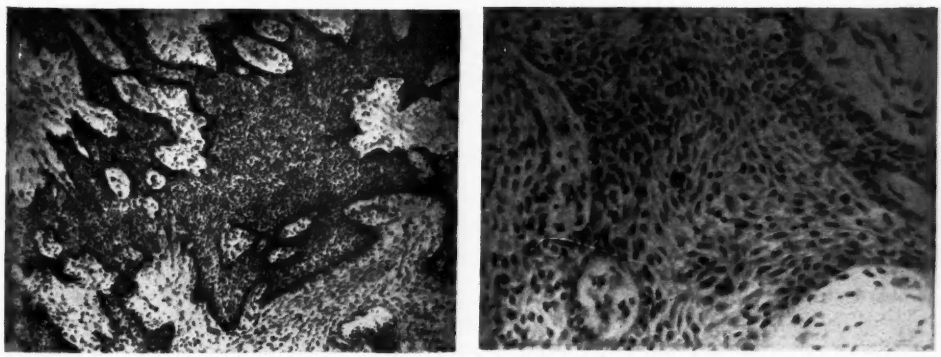

*Fig.* 2.—Photomicrographs of sections from the tumour.

A history of previous radiographs at another hospital seven years ago was obtained. At this time a diagnosis of a dental cyst on the right third mandibular molar was made. The patient refused surgical treatment.

Histological examination showed the tumour to be a squamous adamantinoma. (*Figs.* 2, 3.)

Clinical and radiographic examination six months and one year post-operatively showed no recurrence. (*Fig.* 4.)

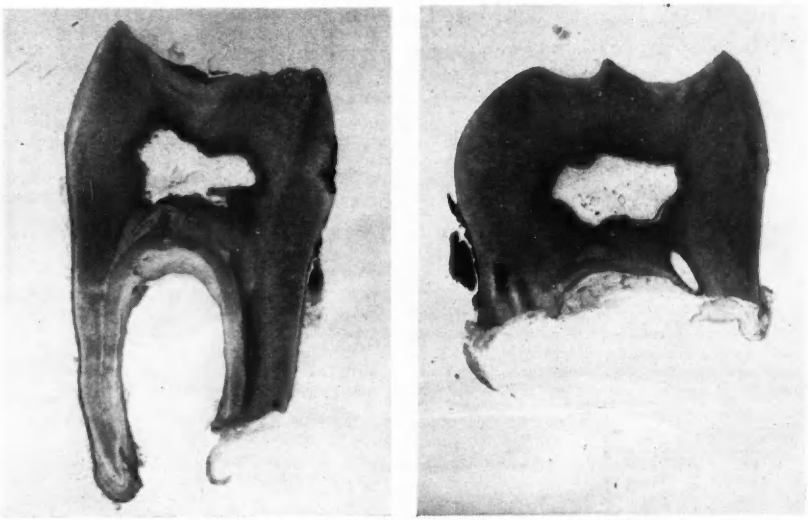

*Fig.* 3.—Sections of the teeth showing pressure resorption of the roots.

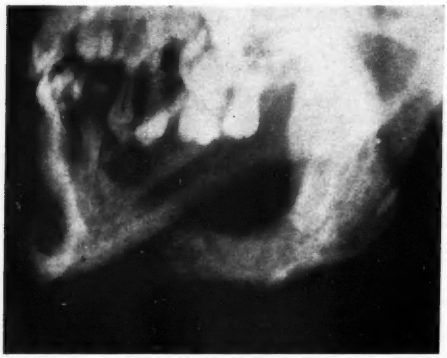

*Fig.* 4.—Shows the radiographic condition one year post-operatively.

Blood examination showed normal white-cell count, hæmoglobin, and alkaline-phosphatase levels.

On April 9, 1954 the tumour and cyst were widely excised. The resulting cavity was saucerized and packed with acriflavine emulsion on ribbon gauze. Uneventful healing occurred.

The specimen consisted of a solid reddish tumour 3 cm. × 2 cm. × 1·5 cm., to which were attached two molar teeth. The teeth were easily separated from the tumour. There was gross resorption of their roots.

An attempt was made to obtain the radiographs taken in 1947 in order to assess the rate of growth of the tumour. These radiographs had been destroyed and only the report retained. The report read: "There is a small dental cyst involving the roots of the lower right third molar tooth" and was dated June, 1947.

**Comment.**—It is thought that this case is of interest in view of the atypical radiographic appearance of the tumour and the length of its known history. The case is being followed up.

I wish to thank Mr. J. H. Hovell for permission to publish the case, and Professor Lucas for the pathology reports and photomicrographs.

## EUROPEAN ORGANIZATION FOR RESEARCH ON FLUORINE AND DENTAL CARIES PROPHYLAXIS

THE Third Meeting of the Organization will be held at Marbourg an der Lahn on June 9 and 10. Details of the programme and social arrangements may be obtained on application.

# THE CLINICAL ASPECTS AND PHYSIOLOGICAL MECHANISM OF ABNORMAL PATHS OF CLOSURE*

By **R. J. G. GREWCOCK** and **C. F. BALLARD**

## PART I

*(R. J. G. Grewcock)*

THE normal path of closure may be defined as *the pathway taken by the mandible when it moves almost as a hinge from rest position to centric occlusion*, and until further investigation has proved otherwise it is assumed that during this movement, no forward translation of the condyles takes place on opening, except when rest position has been exceeded.

### BASIC POSITIONS OF THE MANDIBLE

In order fully to appreciate the path of closure it is necessary to study those basic positions of the mandible which constitute the boundaries of this movement.

**1. Rest Position** is *that position of the mandible in which it is suspended involuntarily by the muscles of mastication, constituting a co-ordinative balance of the elevator and depressor muscles in tonus.*

When the lower jaw is at rest, the teeth are not, as may be supposed, in occlusal contact with the maxilla but are separated by a space, the interocclusal clearance (freeway space), which is variable between individuals usually within the limits of 2–4 mm.

Rest position is thought to be established at about the third month of life and to remain fairly constant in health throughout the life of the individual, being unaffected by the presence or absence of teeth (Thompson).

It may be modified by certain conditions, namely:—

*a. The hypotonicity* often present in fatigue or disease, either of which can produce generally diminished muscle tone, and during sleep.

*b. The hypertonicity* of exaggerated muscle function, terminating as it often does in contractural spasm.

*c. Unconsciousness or deep anæsthesia*, when it becomes non-existent.

Ricketts has demonstrated positional variations of rest position in Angle's Class II malocclusions and states that the mandibulocranial relationship is forward of normal in these cases, but is restored to normality following treatment of the deformity.

Every physiological act of the human body has a beginning and must be capable of a termination. Mastication is no exception to this rule, since all free movements of the mandible begin and end in rest position.

**2. Centric Occlusion** has been defined by Sicher as "that position of the lower jaw in which teeth, temporomandibular joints, and the musculature are in perfect balance".

It will be noticed that emphasis is laid on the importance of occlusion being accepted as a part of an integrated interdependent functional system.

### CONCEPT OF OCCLUSION

In the past too much emphasis has been placed on occlusion as an anatomical, static condition, in which normal arch form, proper interproximal contact relations, correct axial inclinations, and maximum contact of the occlusal surfaces are the sole criteria of an ideal occlusion. Too often assessment is made by virtue of the interdigitation of the teeth on a set of models, where no evaluation of the relationship with function could be assessed.

Investigation has shown, however, all too clearly, that the most important concept is one of function, a dynamic state in which

* Reprinted from the 1954 Transactions of the European Orthodontic Society.

occlusion in its physiological sense is regarded as being an integrated part of a functional system.

*The main parts* which constitute this functional system are as follows:—

1. The musculature.
2. The teeth and their supporting structures.
3. The temporomandibular joints.

**1. The Musculature,** which consists of elevator and depressor muscles of the mandible and

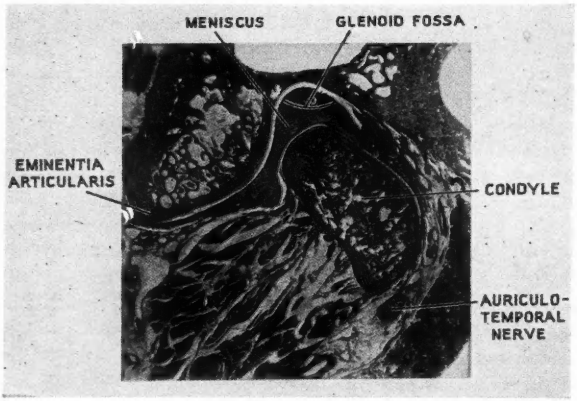


*Fig.* 1.—Section through normal temporomandibular joint (*with acknowledgements to S. W. Chase, Western Reserve University, U.S.A.*)

accessory ligaments, may be considered to represent the most unchanging and unadaptable part of the mechanism. Physiologists of recent years have little to add to the statement of Mershon who says, "muscles have the power to contract and relax. After maturity they cannot be lengthened or shortened except as a result of disease or surgery".

**2. The Teeth and Their Supporting Structures.**—A more labile state exists, however, with the teeth and occlusion than with the musculature, so that an ideal state of functional unity does not always exist.

During growth of the individual, disharmony between maxillary and mandibular teeth may develop which produces premature cusp contact during the normal path of closure, causing the mandible to adopt a bite of convenience with an abnormal mandibulo-cranial relationship. In this case it is likely that a conditioned reflex establishes movement of the mandible from the rest position direct to the eccentric intercusping relationship without reference to centric.

In the adult, changes in normal cusp interdigitation can result from extraction of a tooth and following non-replacement, tipping or drifting of adjacent teeth or over-eruption of its opponent. Of particular practical significance in the production of occlusal imbalance is the neglect to adjust to the occlusion, newly inserted fillings or inlays. The resulting acquired intercusping position can produce either forward, lateral, or backward position relative to centric of the mandible.

What are the effects of abnormal stress on teeth and their supporting structures? All teeth and their supporting tissues require physiological stresses for their normal development and maintenance. As with the long bones of the body excessive stresses in an axial direction are more capable of being withstood than in a lateral direction.

Kronfeld has shown that the periodontal membrane of a tooth out of function is considerably narrower than that of a tooth receiving normal forces; decreased function, at the same time, leads to a modification in the supporting bone, the trabeculæ being less numerous and thinner. Supporting bone is a sensitive plastic material, which as the result of excessive stress in a lateral direction,

resorbs on the side of the tooth to which pressure is applied. Extra stress in an axial direction, however, will often produce sclerosis and general increase and strengthening of the bone trabeculæ. It can be said then that the ideal state of occlusion exists when each tooth is in contact with its opponent in such a way as to subject its supporting tissues to stresses which they are best able to withstand. It would appear unlikely that trauma *per se*, following abnormal tooth contact, is the primary factor in periodontal disintegration, although satisfactory treatment of the disease must of necessity depend on its correction.

The third and perhaps most interdependent parts of the functional masticatory system are the temporomandibular joints.

**3. Temporomandibular Joints.**—In centric occlusion, the relationship of mandible to cranium produces normal positioning of the condyles in their respective fossæ, a state which is disturbed only when the development of an abnormal intercusping relationship causes the mandible on closure to adopt an eccentric position.

Occlusion, then, determines the position of the condyles in their respective fossæ, emphasis being laid on the fact that the mandible has two condyles but moves as one unit.

In order fully to appreciate malpositioning of the condyle and its sequelæ it is necessary to study the anatomical normal (*Fig.* 1). It will be seen that the condyle is situated in the fossæ with its anterosuperior surface adjacent to the postero-inferior surface of the eminentia articularis, the normal relation occupied when the teeth are in centric occlusion. The joint space in the area between the outer surface of the condyle and the concavity of the fossa and its significance will be more appreciated when radiographic interpretation of the post-normal condyle is made (*Fig.* 5).

When the intercusping position and centric occlusion are not identical, the condyles, moving as a unit, are similarly guided out of their true positions and adopt correspondingly false positional relationships.

Extreme retrusion, however, is, in most cases, prevented anatomically by the posterior articular lip of bone which makes pressure on and absorption of the tympanic plate impossible.

Discussion of temporomandibular joint dysfunction would not be complete without mentioning Costen's syndrome.

## COSTEN'S SYNDROME

Costen has described a symptom complex related to dysfunction of the mandibular articulation, covering such widely divergent subjective symptoms as impaired hearing, tinnitus, severe headaches, glossodynia, and metallic taste in the tongue, etc. His investigations were carried out on the cadaver and his findings assessed solely on data obtained in the absence of muscle tone and it is now thought that, as a result, inaccurate anatomical data have been handed down from one article to another. No divergence of opinion exists, however, in his appraisal of symptoms but rather in his conception of cause and effect.

A more logical explanation of the symptoms can be found in studying the pathology resulting from alteration to the mechanical loading of the joints in imbalance and the causal relationship this bears to the reflex neuralgia produced throughout the distribution of the trigeminal nerve.

## CAUSES OF TRAUMATIC TEMPORO-MANDIBULAR JOINT DISTURBANCES

**1. Muscular,** under which heading we deal firstly with *bruxism* or forced grinding of teeth which can occur at times of tension but, in the writer's opinion, is more often the result of the patient's subconscious attempt to grind in and adjust for himself an occlusion which examination will show to be out of centric (*Fig.* 2).

*Muscular hyperactivity*. In normal closure the retruding fibres of the temporal and masseter muscles cause retraction of the condyles, but they are opposed by the external pterygoid muscles which ensure a balanced position of the mandible and prevent exaggerated retrusion of the condyles. If the retracting fibres win this muscular battle, the condyles are pulled upwards and backwards, sometimes with a snapping noise as they override the posterior part of the disk which remains in an almost normal position relative to the articular

eminence. Sometimes the initial opening movement is achieved with difficulty since the condyle must again ride over the edge of the disk which provides an obstacle to smooth movement.

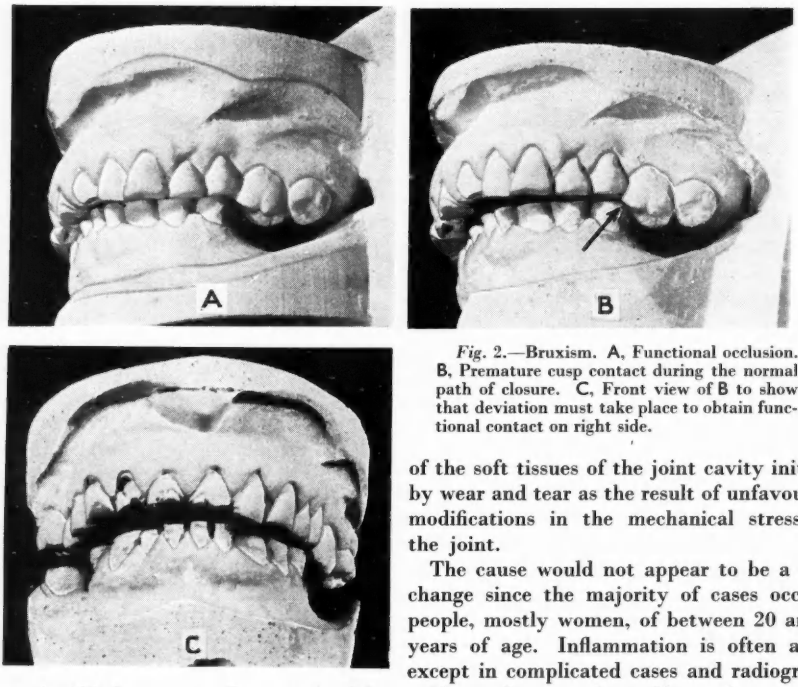


*Fig.* 2.—Bruxism. A, Functional occlusion. B, Premature cusp contact during the normal path of closure. C, Front view of B to show that deviation must take place to obtain functional contact on right side.

**2. Posterior Displacement.**—In some Angle's Class II, division 2, cases, the path of closure from the rest position to occlusion is upwards and backwards, the upper incisor teeth acting as an inclined plane and producing a backward displacement and posterior mandibulo-cranial relationship (*Fig.* 3).

Premature cusp contact during the normal path of closure will sometimes prevent the teeth occluding in centric occlusion so that a consequent eccentric position of the mandible is adopted on forced closure (*Fig.* 4).

## LOGICAL EXPLANATION OF SYMPTOMS

It is customary now to consider temporomandibular joint disorders of the type referred to in this paper as an "arthrosis" or "disease of the joint" (Dorland) being distinct from those diseases of congenital, neoplastic, or infective origin.

The condition primarily appears to be characterized by a progressive degeneration of the soft tissues of the joint cavity initiated by wear and tear as the result of unfavourable modifications in the mechanical stresses of the joint.

The cause would not appear to be a senile change since the majority of cases occur in people, mostly women, of between 20 and 30 years of age. Inflammation is often absent except in complicated cases and radiographic evidence shows no signs of bony change except in very few of the more advanced cases. Pain in temporomandibular joint arthrosis can be referred throughout one or more branches of the trigeminal nerve and occurs probably as a reflex neuralgia initiated by irritation of the capsular branch of the auriculo-temporal nerve. The stimulus is provided by retroposition of the condyle and pressure on the vascular pad of connective tissue behind it (*Fig.* 1) or at a later stage by degenerative changes in the joint capsule itself. Limitation of movement in the joint is thought to be due to "bunching up" of the meniscus and/or periarticular muscle spasm, which itself is sometimes the cause of pain outside the joint cavity.

## TREATMENT

It has been emphasized that the mouth is a functional system of which one of its integral parts, the musculature, is relatively unchanging. The mandibular articulations are mechanically labile so that treatment is confined to the re-establishment of the occlusion, on which depends the correct seating of the condyles in their respective fossæ.

The objective of treatment is to re-establish a state of harmony between all the integral parts, so that effective mastication is ensured and the parts during function are not subjected to injury or undue stress.

## CLINICAL EXAMINATION

*All teeth* are examined for evidence of attrition facets and particular reference is made with regard to raised fillings and freedom (or otherwise) of mandibular excursions. Instanding lower molars, missing or tilted posterior teeth are indicative of bite closure which is checked by measuring the inter-occlusal clearance.

Many ways of determining this space are available. A simple method is to take the two measurements from the columella of the nose to the symphysis mentis, the mandible being first in occlusion and then in rest position. The difference between the two readings is the inter-occlusal clearance (freeway space).

Further confirmation of bite closure can be obtained by comparative radiographs of the condyles taken in rest position and occlusion, a technique which has been described elsewhere by the author.

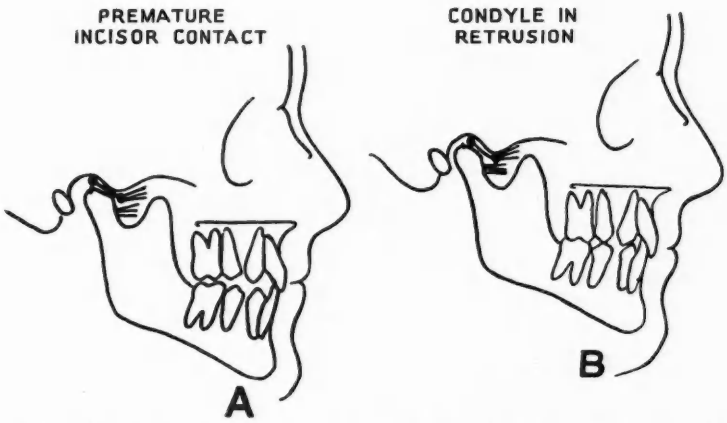


*Fig.* 3.—Class II, div. 2, showing upward and backward path of closure. The condyle in retrusion sometimes overrides the meniscus B.

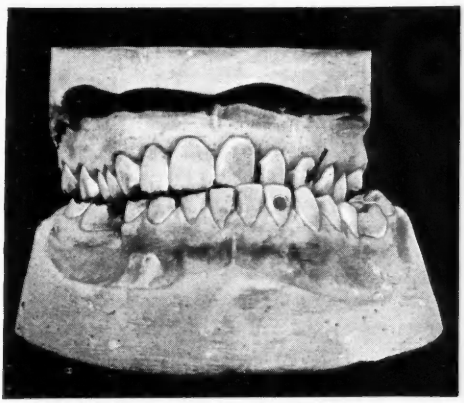

*Fig.* 4.—During the normal path of closure, premature contact of $\overline{3}$ occurred causing left lateral deviation of mandible.

Attention is next paid to the *gingival and supporting structures of the teeth.* Careful examination is made to discover the presence

of subgingival pockets and whether the condition is limited or extensive. Localized pocketing around teeth which are in opposition will often give an indication of trauma occurring in lateral excursive movements. A history of repeated gingivectomy arouses suspicion that excessive stresses are being applied to those teeth affected during some period of mandibular movement.

Deviation of the mandible on opening (or closing) is consistent with obstruction to anteroposterior movement of the condyle on the same side to which the symphysis moves.

Complete forward movement of the condyle on opening is sometimes prevented by heaping up of the meniscus, so that following sudden overcoming of this obstruction, the condyle jerks forward with the characteristic snapping sound.

The degree of deviation can best be assessed by noting the relationship in occlusion between a fixed point, such as the midline of the mandibular incisor teeth with the upper median diastema. Comparison is then made with the mouth in open position.

*In temporomandibular joint arthrosis* which may be unilateral or bilateral the usual subjective symptoms presented are pain, swelling (seldom), crepitus or snapping on movement. Pain is sometimes experienced in the joint itself although more often it is referred as a reflex neuralgia to the ear, the mastoid region and the supra-orbital and infra-orbital areas, the latter so often being misdiagnosed as pain manifestations of chronic antral disease.

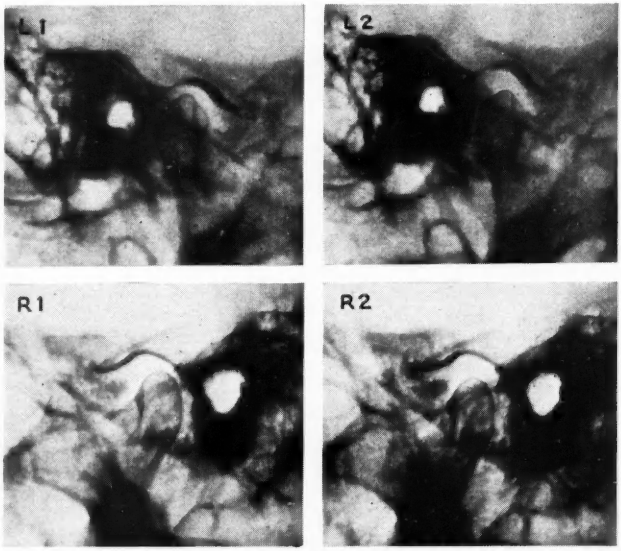


*Fig.* 5.—Temporomandibular joint X-rays of a Class II, div. 2, case. L1 and R1 are right and left condyles in retrusion during occlusion. L2 and R2 are taken during rest position.

*Recurrent stiffness of the neck muscles*, usually on the affected side, occurs in a large number of cases and disappears following successful treatment of the joint condition.

The explanation of this phenomenon is not simple, but until a more satisfactory answer can be given it is accepted as being associated with the dis-equilibrium produced in the complex co-ordinated ring of muscles which maintain the head in posture.

*Difficulty of opening* the mouth on waking is often attributable to bruxism, which produces some degree of trismus following the exaggerated function to which the muscles have been repeatedly subjected.

*Tiredness in the head* and a desire to protrude the mandible are subjective symptoms of mandibular arthrosis, sometimes associated with mandibular overclosure, the latter being an unconscious effort on the part of the patient to relieve the pressure produced by the retroposed condyles. Many efforts have been made to explain the fact that occasionally head noises, tinnitus, and even some degrees of deafness certainly have been relieved following oral rehabilitation, but a logical explanation has yet to be found. Whether mandibular overclosure and condylar retrusion can in some way and at some times be held responsible for interference with normal vascular or lymphatic drainage of the Eustachian tubes and their consequent blocking with mucus can be regarded only in the light of an unproved but possible conjecture.

## TEMPOROMANDIBULAR JOINT X-RAYS

In cases of suspected mandibular overclosure and condylar retrusion, radiographs can be used as accessory aids only to good clinical judgement.

Many methods have been devised, but the principle underlying the concept is the same in most cases. If we accept the premiss that movement of the mandible from the rest position to occlusion is almost a hinge movement, radiographs taken through the hinge axis (situated in the condyle) in these two mandibular positions will show no translatory condylar movement. The patient's head and the X-ray tube are kept motionless for the two exposures. In some cases of mandibular overclosure retrusion of the condyle(s) will be seen as radiographical evidence in support of clinical findings (*Fig.* 5). It should be emphasized here that many cases of deep bite *clinically* appear to be closed but in fact are not so. Each case must be treated on its merits and every available means used to obtain a correct diagnosis before treatment is attempted.

## RATIONALE OF TREATMENT

Treatment is confined essentially to the establishment of a harmonious relationship between the teeth in occlusion (static condition) and during articulation (dynamic).

The objectives concerned with the establishment of occlusal harmony can be summarized as follows:—

1. *Centric Occlusion.*

The restoration to centric occlusion of any abnormal intercusping relationship.

2. *Free Lateral Gliding.*

The establishment of harmonious cusp relationships of upper and lower teeth to facilitate smooth gliding in all excursive movements of the mandible. It has already been shown that *lateral* stress to the point of overload will cause progressive destruction of the paradontium. Cusp inclines in youth can be steep, but progressive attrition should reduce tooth leverage as tissue resistance diminishes with age.

3. *Equal Distribution of Stresses.*

In centric occlusion and during excursive movements an ideal state of equilibrium is sought to ensure that all teeth are stressed as uniformly as possible.

4. *Retention or Re-establishment of the Normal Occlusal Vertical Dimension.*

The normal occlusal vertical dimension can best be measured accurately in the young adult, because of the small amount the cusps have worn.

It is reasonable to suppose that in the normal attrition pattern the occlusal vertical dimension is largely maintained by means of vertical growth of the tooth-bearing tissues.

Only when *excessively* rapid attrition occurs can it be presumed that wear of the teeth exceeds the compensating vertical growth of alveolar bone. A normal occlusal vertical dimension assumes a harmonious relationship between the elevator and depressor muscles of the mandible as well as the correct unstrained positioning of the condyles in their fossæ.

Any increase above normal, that is, encroachment on the interocclusal clearance, will result in a depression of the teeth until the physiological occlusal level is once more reestablished, a situation which emphasizes the importance of a most careful clinical and radiographical assessment of this measurement.

**CLINICAL CONDITIONS WHICH DEMAND ESTABLISHMENT OF OCCLUSAL HARMONY**

**1. Recurrent Gingival Conditions and Bruxism.**—Cases which have necessitated more than one gingivectomy should be checked for centric and during excursive movements, and if required correction of the occlusion carried out by selective grinding.

**2. Æsthetic Conditions.**—In some cases of apparent Angle's Class III, the forward positioning of the mandible is the result of premature cusp contact during the normal path of closure. Retrusion in centric can often be maintained by suitable overlays (*Figs.* 6, 7).

**3. Loss of the Occlusal Vertical Dimension.**—Emphasis has already been made of the

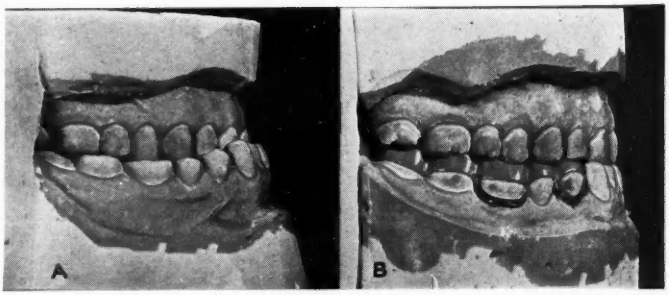


*Fig.* 6.—A, Functional occlusion in pseudo Class III position. B, Centric maintained by means of a removable overlay appliance.

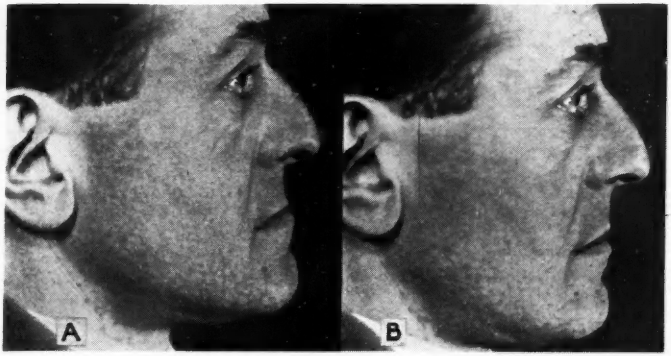


*Fig.* 7.—Same case as *Fig.* 6. A, without appliance. B, with appliance maintaining centric.

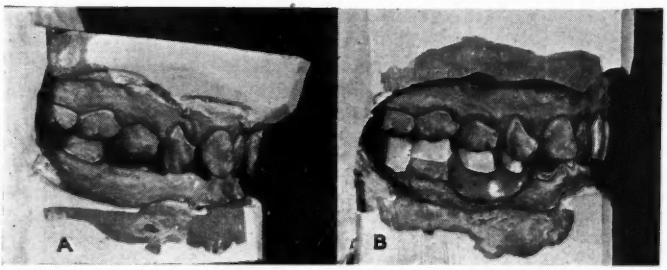


*Fig.* 8.—A, Showing loss of occlusal vertical dimension. B, Restoration of occlusal level by means of partial denture overlay.

importance attached to accurate assessment of the degree of bite closure present.

When in doubt, it can be said that under-opening is better than over-opening since encroachment on the interocclusal clearance will result in failure.

Restoration of the occlusal level to the normal is made by means of removable overlay appliances or fixed onlays and bridge work, care being taken to observe the principles of centric, free gliding and equal stress distribution during reconstruction (*Fig.* 8).

Much can be done to restore function by re-establishment of the normal occlusal level, at the same time observing the principles of balanced articulation in the reconstruction.

Lateral view radiographs of the joints are also of value in checking the degree of bite opening obtained during the construction of an overlay appliance.

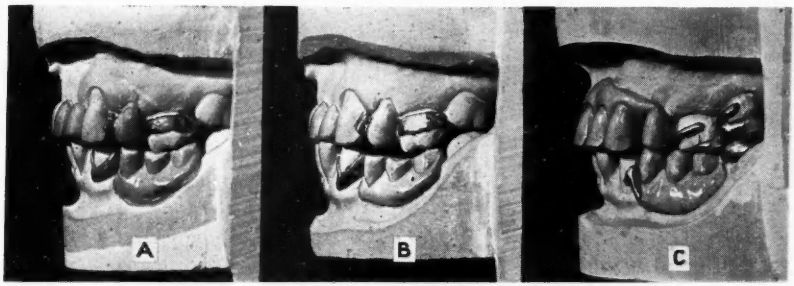


*Fig.* 9.—A, Functional occlusion with mandible in retrusion. B, Premature incisor contact during normal path of closure. C, Restoration of centric with new partial dentures, allowing mandible to remain forward in centric relationship.

**4. Temporomandibular Joint Disorders.**—Arthrosis of the mandibular articulation occurs mostly as the result of an alteration in mechanics unfavourable to the joint. Since the movements, positions, and loading of the joints are dependent largely on the relationship of upper and lower teeth in occlusion as well as on the activating musculature, any deviation in the occlusal dental relationship will produce an influence on the articulations, damaging to their mechanical well-being (*Fig.* 9).

Following condylar retrusion, often the initiating factor to joint disorder, irritation to the vascular pad of connective tissue between disk and posterior capsule leads not only to reflex neuralgia but also to progressive destruction of the synovial membrane.

The resistance of the articular structures is, in consequence, lowered and the way paved to degenerative changes of the entire articulation, commencing with the soft tissues and ending ultimately in destruction of the bone itself.

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# BOOK REVIEWS

**A TEXT-BOOK FOR DENTAL ASSISTANTS.** By IRWIN ROBERT LEVY, Director, Dental Assistants Division, Eastern School for Physicians' Aides. Fourth Edition. $9\frac{1}{4} \times 6$ in. Pp. 293, with 237 illustrations. 1955. London: Henry Kimpton. 34s.

THIS is the fourth edition of a popular American book for the chairside assistant in which there are many useful sections including ones on Dental Office Management, Sterilization, Dental Radiology, Model Casting, and Gold Inlays.

Though this book is for dental assistants, in many parts the author seems trapped in the traditional style of the professional textbook. The subheadings Etiology, Diagnosis, Symptoms, and Treatment constantly recur and give a strong impression that this is a "potted version" of some more dignified tome. A chatty style with the accent on the practical role of the nurse would make this a more readable book for the lay person.

There seems, too, to be a lack of appreciation of the educational background of the intended reader. A little knowledge is a dangerous thing and the attempt made here to give the whole of dentistry in 293 pages can only lead to confusion. The fear of leaving something out must be overcome. The section on Tumours and Neoplasms serves as an example. In ten lines tumours are explained! Then follows a list of tumours, 17 in number and with no explanation other than teratoma (dermoid), lymphangioma (lymphatics), etc. Finally four of the list are selected for further elucidation, the peach of these being sarcoma which is discussed under the histological subdivisions of round cell, spindle cell, and giant cell.

It is doubtful if a dental assistant can comprehend what a cell is let alone understand any of this section. Better to have elaborated on dental materials. Information on the effect of temperature, time, humidity, powder/liquid ratio, etc., on their manipulation and set is the stuff to instil in these days of scientific dentistry. Zelex, plaster, and cements, for instance, are scantily dealt with though oxyphosphate for cementation of inlays is adequately mentioned.

The "Dictionary Containing 1500 Commonly Used Dental Terms" forms an excellent conclusion. The author, however, in an all-out effort to reach his 1500 entries maligns the intelligence of his readers. "Fix" we are told is "to attach or secure" and a "Toe" is a "digit of the foot".

When he suggests that any American girl has to be informed that a "Lip" is "one of the two pink structures which surround the orifice of the mouth" he is stretching credulity a little too far.

J. R. G.

**THE PONTOSTRUCTOR METHOD.** By SAM KARLSTRÖM, Odont. Dr., L.D.S., D.M.D. Translated by VICTOR BRAXTON. $6\frac{1}{4} \times 9$ in. Pp. 266. 1955. Stockholm: A. B. Nordiska Bokhandeln. 32kr.

DR. SAM KARLSTRÖM is well known in Europe as one of the leaders in the field of crown and bridge work. His use of retention pins for anchorage of multiple bridge abutments and extensive restorations has caused him much difficulty where parallelism is a major consideration. As a consequence he has spent many years perfecting instruments to overcome this problem. The main result has been a device known as the Pontostructor which is an instrument for holding the handpiece in the upper or lower arch in a permanently parallel position. With this equipment and its accessories, prodigies of precision dentistry are possible.

This book, "The Pontostructor Method", has been divided into three parts. The first is a description and catalogue of the various pieces of equipment invented or modified by Dr. Karlström, mainly in connexion with the Pontostructor. The second section explains the use of the instruments in relation to specific preparations; while the final portion is a review of some of the 900 cases which the author has completed during the past 15 years.

Dr. Karlström presents many interesting points and techniques which are useful to the practitioner who prepares his bridges free-hand. Several pages are devoted to the description of a method for making indirect amalgam crowns. He stresses the value of having the finishing line of crowns a millimetre or two above the gingival margin in selected cases.

"The Pontostructor Method" is extremely well presented on good paper with excellent diagrams and photographs. Victor Braxton is to be congratulated on the translation which was probably a very difficult job.

This book has much to commend it to the specialist in crown and bridge work, and to those who may wish to have more than a conversational knowledge of the Pontostructor. However, as a book for the general practitioner one feels it will have a limited interest.

D. D. D.

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## THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS

### Provincial Meeting

THE British Society for the Study of Orthodontics announce that they are holding a Provincial Meeting which will take place on May 11 and 12, 1956, at the Sutherland Dental School, Newcastle upon Tyne. The Provisional Programme includes two papers on Friday morning and two on Friday afternoon; a symposium on Angle's Class II, Division 1 aetiology and treatment on Saturday morning; and table demonstrations on Saturday afternoon.

There will be a formal dinner for members, guests, and visitors on the Friday evening.

Meeting headquarters will be at the Grand Hotel, Newcastle upon Tyne, and those proposing to attend should reserve accommodation by direct booking, to the manager of the hotel.

The meeting will be open to non-members on payment of the conference fee of 1 guinea, and non-members desiring to attend should apply to the Hon. Secretary, Mr. H. L. Leech, The Royal Dental Hospital, 32 Leicester Square, London, W.C.2.

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## NATIONAL HEALTH SERVICE NOTES

### Dental Apprentices

1. Agreement has been reached on increased salaries for dental apprentices employed in England, Wales, and Scotland by Regional Hospital Boards, Hospital Management Committees, Boards of Management, Boards of Governors of Teaching Hospitals, Local Health Authorities, and Local Educational Authorities.

The revised salaries, which are set out below, replace from September 1, 1955, those set out in paragraph 2 (*a*) of P.T.B. Circular 27; the provisions of paragraph 3 and of Part II of that Circular remain effective.

| 2. *Salaries*:— | £ |
|---|---|
| 1st year | 120 |
| 2nd year | 140 |
| 3rd year | 160 |
| 4th year | 205 |
| 5th and subsequent years | 250 |

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## SEVENTY-FIFTH ANNIVERSARY OF THE FOUNDATION OF THE PARIS SCHOOL OF DENTISTRY

THE Seventy-fifth anniversary of the foundation of the Ecole Dentaire de Paris was held at the Association Générale des Dentistes de France, 45 Rue de la Tour d'Auvergne, Paris, on Sunday, February 26, 1956. In the Chair was M. Porte, representing the Minister of Public Health.

Opening the ceremony, Dr. Deliberos, President of the Administrative Council of the Paris Dental School, received the numerous personalities connected with the Ministries, Senates, President of the Republic, Paris Town Hall, Municipal Council, Deans of the Faculties of Science, Medicine, and Pharmacy, and representatives of overseas dental organizations.

Dr. Audy reviewed the history of the school, the foundation of the first Dental Circle of Dentists and outlined the necessity to create

a Dental School. This initiative, he said, led to the formation of the first school at 23 Rue Richer, Paris, on November 13, 1880, then known at the First Professional Dental School. Its objects were to give instruction to dental students and to form a Dental Hospital free of charge for consultation and treatment.

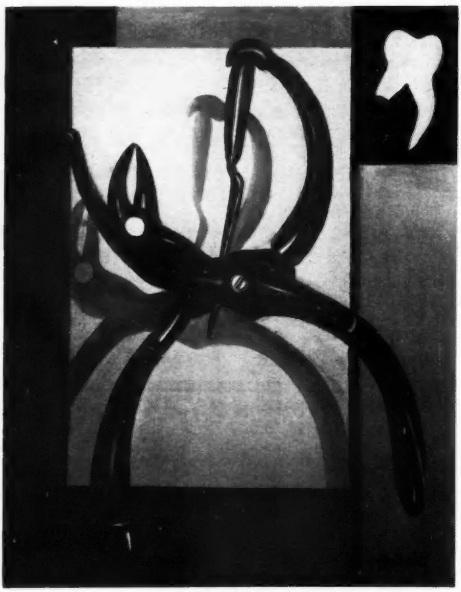
In order to achieve this national philanthropic work a public subscription was raised. The development of the Institution rapidly grew and in 1883 the Société d'Odontologie de Paris was formed, followed in 1884 by the Circle des Dentistes de Paris, which later became the Association Générale des Dentistes de France.

In 1885 a Museum and Library was formed and in 1892 the Institution was recognized by the State as a public utility organization. On November 30, 1892, a law instituted the diploma of Dental Surgeon which was the first official recognition of the French dentist.

The Federation of National Dentistry was created in 1889. Later, in 1900, the first International Federation of Dentistry was formed by Dr. Godon, who was then the President of the former. "Thus", said the speaker, "a Frenchman was the first to organize an international body for the profession. A single figure will illustrate the activity of the School where 8640 students have received training."

## DENTISTS AS ARTISTS

THE Twenty-eighth "Salon des Médecins, Dentistes, Pharmaciens et Vétérinaires" was recently held at the Musée d'Art Moderne, Paris, where over two hundred doctors, dentists, pharmacists, and veterinary surgeons displayed some six hundred paintings, sculptures, photographs, and objects of art. The exhibition was officially opened on Sunday, March 4, by M. Porte, representing the Minister of Public Health, who later made a personal inspection of the exhibits.



Suicide.

As in previous years, Britain was again a guest of the Salon and works of two doctors, three dentists, and two veterinary surgeons were hung which represented the British medical profession. The dentists were Mr. Richard Fidler (Enfield, Middlesex), who received honourable mention for his sketch "A Waiting Room", Mr. Edward Samson (Bournemouth), and Mr. J. M. Straiton (London, S.W.9).

The popularity of the Salon and the importance of it, have now made it a fixed event on the Paris calendar and the French press devoted large spaces to the criticisms of the exhibits.

Dr. De Gennes, President of the Salon, made a broadcast statement prior to the opening of the exhibition. He compared the professional occupation of the doctor with the paintings displayed and concluded that the doctors took up painting as a hobby and that there was no reflection of medicine in their artistic works: not even a bust, a nude, or anything connected with medicine was to be seen in the paintings. The same could not always be said of the dentist, as many works related to professional duties such as our photograph "Suicide", a painting by M. David Solot, a French dentist of Croissy-le-Roi.

# ABSTRACTS FROM OTHER JOURNALS

## Symposium on Jaw Relations and Occlusion in Complete Dentures

(*American Denture Society*, November, 1954)

**1. Selective Occlusion.**—Using Styrene or metal bases which will form part of the finished dentures, a preliminary bite recording is made, the vertical dimension for this being determined by comparison of the rest position and the closure in swallowing. Anteriors adequate to act as guides are set up. After adjustment of the vertical dimension for inter-ridge space on the articulator, the set-up is completed, definitive for the lowers, tentative for the uppers. At the try-in ample time is allowed for the patient to become thoroughly familiar with the wax-up in all movements. When this state is reached, a final bite recording is made by means of an inter-occlusal check bite of accelerated plaster. Further check bites may be necessary after adjustment on the articulator.

The posteriors used may be cusped (interdigitating or not), flat (with sluice ways), or steel insert. Cusped teeth are suitable for cases with prominent ridges in normal or prognathous relation, non-interdigitating cusps or flat surfaces for orthognathous relation. Flat teeth are suggested for flat ridge cases, save for the prognathous case, where non-interdigitating cusps are recommended. Steel insert teeth are suitable where the musculature is powerful.—PAYNE, S. H. (1955), *J. pros. Dent.*, **5**, 301.

**2. Occlusion of Cuspless Teeth for Balance and Comfort.**—The bite is taken with the aid of the Coble balancer, the upper portion of which is a central bearing point, the lower a graph bridge which is secured across the lower shellac base. These are sited so as to coincide with the centres of the supporting areas of the upper and lower ridges. Vertical height is adjusted by means of the central bearing screw, and a Gothic arch tracing made at this dimension on the graph plate. A hole drilled in a plastic overlay on the graph plate locates the central point and plaster check bites are made, after wax occlusion rims have been fitted to the bases.

Porcelain posteriors are used, but acrylic lower anteriors to eliminate chipping of the upper anteriors. A flat jig is adjusted on the articulator and the teeth set in a gentle compensating curve on this. The processed dentures are inserted in the mouth with bearing point and plate temporarily fixed and the point adjusted so that the teeth are just out of occlusion. As the point is screwed up the successive points of contact are stoned free. Second molars are regarded as for balance only and are adjusted according to the Bull rule. The other posteriors are treated by this rule in reverse, in order to eliminate obstruction to the "closure-toward-centric" movement. Deep escapements and cutting cusps are formed with diamond wheels.—PLEASURE, M. A. (1955), *J. pros. Dent.*, **5**, 305.

**3. Cuspless Centralized Occlusal Pattern.**—Bite recording and bite adjustment on first insertion are as in Pleasure (1955) (*see above*). The anterior teeth are set up with no overlap and no contact in centric occlusion. The posteriors are flat, with sharp ridges and occlusal contact on the lingual half only. They are set up so that the occlusal contact is on the lingual of the crest of the ridge and so that the occlusal plane is flat. The second molars are balancing only and the working area is confined to the middle segment of the ridge.—PORTER, C. G. (1955), *J. pros. Dent.*, **5**, 313.

**4. Physiologic Jaw Relations and Occlusion of Complete Dentures.**—After tentative recording of the vertical dimension with conventional wax rims and bases, the lower rim is uniformly reduced 3 mm. and a cone of soft wax anteriorly is moulded by the patient carrying out swallowing movements. A similar process is performed on each side, and the antero-posterior relationship fixed. The lower teeth are set up so that the lingual occlusal curve is flat and the buccal curve is reversed. On first insertion the lowers are covered with wax and the patient is asked to perform swallowing movements. Perforations due to buccal cusps

and incisal edges are reduced on the lower; those due to lingual cusps are located similarly on the upper denture and reduced. Premature contacts in lateral and protrusive non-functional movements are identified and removed in the same way.—SHANAHAN, T. E. J. (1955), *J. pros. Dent.*, **5**, 319.

**5. Occlusal Records.**—Base-plates are used bearing rims of which the upper is of hard wax and the lower is of hard wax faced occlusally with a softer wax. The upper rim is shaped with reference to the interpupillary and ala-tragal lines. The soft wax facing of the lower rim is then formed to an edge and softened and the anteroposterior and vertical relationships are recorded. The casts are mounted on the articulator with the aid of a face-bow and the teeth set. Twenty-degree teeth are used of such a size as not to encroach on the retro-molar pad. At the try-in adjustments are made to the vertical dimension and the casts returned to the articulator. Wax interocclusal records are then made and checked against the articulator setting. If there is any discrepancy the casts are re-set and new records made, the process being repeated until the mouth records and the articulator setting are identical. The articulator is then adjusted with lateral and protrusive bites. After processing, the dentures are ground in on the articulator and final adjustments made with intra-oral records after a period of use.—TRAPOZZANO, V. R. (1955), *J. pros. Dent.*, **5**, 325.

### Extra-oral Force—Facts and Fallacies

One hundred Class II, division 1 cases treated with extra-oral force were studied in order to assess the effects and the limitations of treatment with extra-oral force. In some cases bite plates were used because it was found that extra-oral anchorage alone was inadequate for control of vertical discrepancies, where the overbite was excessive. Nevertheless, overbite correction, with or without bite plate assistance, remains one of the most difficult treatment objectives, using extra-oral force alone.

In the deciduous dentition (14 cases) general response was slow despite excellent co-operation on the part of the patients. In the mixed dentition (50 cases) a better response was observed. Overjet correction in some cases from both deciduous and mixed dentitions meant excessive lingually inclined incisors. Removal of maxillary second molars undoubtedly paved the way for mesiodistal adjustment. Growth increments facilitated treatment at all ages, and this was particularly evident with the pubertal growth spurt in the permanent dentition group.

That maxillary alveolar growth can be influenced was clear from the routine change in anteroposterior apical base relationship, but there was no evidence that maxillary growth *per se* was affected. The effect on maxillary first molars was generally restraint or distal tipping, but bodily movement can be accomplished. Despite excellent results in reducing the anteroposterior discrepancy, it is all too apparent that those apical base differences that remain present overjet problems that can only be corrected by excessive lingual inclination of the maxillary incisors and/or labial inclination of the lowers. There was no evidence that removal of occlusal interferences resulted in increased mandibular growth.—GRABER, T. M. (1955), *Amer. J. Orthodont.*, **41**, 490.

## EXAMINATION RESULTS

### UNIVERSITY OF DURHAM

*March*, 1956

The following students have satisfied the examiners:—

**Degree of Bachelor of Dental Surgery** (*Fourth Examination, Part I*):—

Aaron, R.; Abbott, E.; Abrahams, M.; Adair, B.; Bancroft, G. H.; Bluck, D. R.; Charlton, G.; Clark, A. M.; Clucas, R.; Cowell, T. A.; Dewell, D.; Etherington, Miss L.; Gough, N. G. (with distinction); Harrison, T. D.; Howlett, R. A. N.; Hunter, J. B.; Ipaktchi, A. H.; Madhoo, P.; Marshall, G.; Matthews, C. S.; Morgan, A. R.; Neden, Miss J.; Neverlien, P. O.; Redhead, P. A.; Ridley, T. J.; Rowlay, Miss R. A.; Spencer, J.; Stubbs, J. M.; Vorster, S. W.; Wallace, J. D.

**Licence in Dental Surgery** (*Fourth Examination, Part I*):

Annis, M. R.; Christelis, A.; Ferrell, R. S.; Harper, M. J. G.; Joyce, M. W.; Levin, H.; Naru, B. S.; Newman, E. H.; Nirsimloo, P. C.; Pepple, Miss G. A.; Resser, O.; Rosen, M.; Rothfield, J. S.; Sowter, P. J.; Widdicombe, J. R.; Wold, K. O.; Wright, E. B.

**Degree of Bachelor of Dental Surgery** (*Fourth Examination*):—

Forehead, D. R.